## REMARKS

The claims were rejected as being obvious in view of any of the Emmett patents or the Harrison publication. The Applicant respectfully traverses. The Examiner asserts that Emmett discloses some type of solid/liquid separation to form a material containing metal in solution and microorganisms, and separating these microorganisms from the remaining material. The Applicant has carefully reviewed each of the Emmett patents and does not find support for the Examiner's conclusion.

For example, the Examiner refers to "separating by a centrifugal process" (US 4,732,608 at col. 6 line 30). The portion the Examiner refers to, however, states:

> The control of soluble constituents in the reaction slurry may be achieved by the removal of suspended solids-free liquor from the slurry while retaining the bacteria within the slurry.

This is contrary to the claimed process. In other words, the bacteria **are not separated** from the supernatant or from the remainder of the slurry but are retained, mixed with other solids, when the solids-free liquor is separated. Thereafter "all captured solids are recycled to the bioreactor" (col 6 lines 34 and 35). In contrast, in the present invention, the microbial cells only (without mineral solids) are to be recycled back to the reactor in order to increase microbial cell concentration and thus also to increase the rate of microbially catalyzed processes in the reactor. Recycling of mineral solids (with or without cells), as described by Emmett, could in fact be detrimental to the biological process as it would add to the solids loading and shear force effects in the reactor. Thus, Emmett does not teach or suggest the presently claimed invention.

Moreover, it is inaccurate to assert that the prior art "indicates recycling the microorganisms back to the reactor". More accurately, the prior art teaches that all captured solids, which include the microorganisms, are recycled to the bioreactor. This distinction is in fact underscored by Emmett at, for example at col 5 lines 5 to 13 and at col. 12 lines 23 to 68 (the '608 Emmett). In the last-mentioned portion of the specification an example is described wherein the water/slurry mixture is directed to a cyclone. As pointed out below, a hydrocyclone cannot remove bacteria in isolation from a concentrate because of the low specific gravity of the bacteria. Clearly, all of the solids (including the bacteria) can be removed through the use of a hydrocyclone. The earlier reference to the separation of liquid and solids by the use of "a cyclone, centrifuge, or clarifier" at col 6 line 30 of the '608 patent simply means that the centrifuge and clarifier would be used in the same way as the cyclone i.e. to separate all solids from the liquid. The separation of the microorganisms from the supernatant (without the mineral solids) or from the remaining mineral solids could therefore not have been contemplated by Emmett. This type of separation is in fact not taught or suggested by Emmett. Therefore, the Applicant requests that the rejection be withdrawn.

As for Harrison, the Examiner asserts that one of ordinary skill in the art would realize that separating microbial cells from metal in the supernatant should be included when performing the Harrison process because "it is a reasonable assumption that the bacteria are in fact separated from the metal in the supernatant". Applicant cannot

agree. The bacteria cannot be separated from the concentrate using the technique described by Harrison because the specific gravity of the bacteria is too low. Therefore, the Applicant respectfully requests that the Examiner supply some factual evidence for the assumption.

Moreover, as the Applicant points out in paragraph 5 of the present specification,

> "microbial recovery of cells from bioleach bioreactors is significantly more complex than the operation of a typical activated sludge plant used for wastewater treatment. In the case of wastewater treatment two phases exist, viz the biomass sludge phase (biological solids phase) and the liquid phase. In the case of bioleaching reactors three distinguishable phases exist, viz the mineral solids particles (mineral solids), the microbial cell biomass (biological solids phase) and the liquid phase. In addition, the microbial solids phase is not as uniform as in the case of activated sludge plants. In the bioleaching scenario, biological solids are either attached onto the mineral particle surfaces or freely suspended. Separation of the biomass phase from the other phases poses significant technical difficulties and challenges.

Harrison simply confirms Applicant's understanding and in fact, teaches away from the present invention. Harrison concludes that the major fraction of the bacterial population in the bioleaching slurry is associated with the solid phase (p. 534). Indeed, Harrison found that "the recovery of bacterial activity is a function of the recovery of the solid phase" and that "most of the bacterial population is associated with the solid phase" (p. 533). Thus, Harrison seeks to separate particles having a size less than 20 μm from those having a larger size. This separation is a differential solids separation process – not a solid-liquid separation. Harrison, however, does not teach subjecting a metal containing slurry to a solid-liquid separation to form a supernatant and then further

treating the supernatant to separate the microbial cells from the supernatant. Therefore, the Applicant requests withdrawal of the rejection.

Applicant believes the present claims are allowable and respectfully request allowance of the application. The Examiner is invited to contact the undersigned attorney at (312) 321-4276 to resolve any outstanding issues.

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Respectfully submitted,

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